

REMARKS

The present invention relates a battery separator. In the Office Action of June 23, 2003, claims 1-16 were rejected under 35 U.S.C. § 112, second paragraph, particularly with respect to the recitation in claim 1 and as to what is encompassed by the claimed “non-woven fabric”, and with respect to use of the term “type” at line 3 of claim 3. Furthermore, claims 1-16 were rejected under 35 U.S.C. § 103(a) based Aikawa et al (U.S. Patent No. 6,284,680) in view of JP-11-126595 (JP ‘595). Lastly, claims 1-16 were rejected for obviousness type-double patenting with respect to claims 1-6 of U.S. Patent 6,284,680.

In response, Applicants have herein above amended claims 1 and 3, including incorporation of recitations from claims 2 and 4 into claim 1 (with claims 2 and 4 accordingly being cancelled), and to eliminate the term “type” in claim 3. Claims 8 and 9 were accordingly amended as to the dependency of those claims. It is respectfully submitted that the claims are now clearly in complete compliance with the requirements of 35 U.S.C. § 112, and the rejections based thereon should be withdrawn.

Furthermore, for reasons discussed in detail below, it is respectfully submitted that claims 1, 3, and 5-16 now pending in accordance with the present amendment are clearly patentable over the cited art of record and distinguished over the Aikawa et al ‘680 patent such that the obviousness type double patenting rejection should be withdrawn. Still further, one of Applicants has conducted experiments, reported in a Declaration Under 37 C.F.R. § 1.132 simultaneously submitted herewith, which further evidences the unobviousness of the present

invention vis-a-vis the cited art. A detailed explanation regarding the distinctions of the present invention is set forth below.

Characteristic features of the present invention

Important features of the battery separator of the present invention include that (i) the nonwoven fabric contains high-modulus fibers having a Young's modulus of 50 cN/dtex or more (hereinafter simply referred to as "high-modulus fibers"), and (ii) the nonwoven fabric has a substantially unilayered structure.

As described on page 5, line 2 from the bottom to page 6, line 8 of the present specification, because of the above feature (i), i.e., the elasticity of the high-modulus fibers, a short circuit caused by a penetration into the separator by a flash generated at the electrode is avoided, and the separator is prevented from being torn by an edge of an electrode, when the separator is wrapped around the electrodes. Therefore, a battery can be reliably assembled. Further, moderate voids are maintained in the separator after wrapping the electrodes, and an electrolyte can be held for a long time. Therefore, a battery having a long lifetime can be assembled. In other words, the elasticity of the high-modulus fibers can improve the resistance to penetration of a battery separator, and thus a battery having a long lifetime can be reliably assembled.

As described on page 3, lines 1-6 and Table 1 of the present specification, because of the above feature (ii), i.e., a substantially unilayered structure, an electrolyte can be evenly held

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throughout the nonwoven fabric, and therefore, a battery having a low electrical resistance and a high capacity can be assembled.

The Aikawa et al reference (U.S. Patent No. 6,284,680)

As pointed out by the Examiner, the Aikawa et al reference does not disclose the “high-modulus fibers” contained in the battery separator of the present invention. Therefore, the battery separator of the present invention is different from the nonwoven fabric disclosed in the Aikawa et al reference, with respect to the presence or absence of the “high-modulus fibers”.

As described in the above item 2(a), the elasticity of the high-modulus fibers can improve the resistance to the penetration of a battery separator. To show the effect of the presence of the high-modulus fibers in a battery separator, one of the Applicants has conducted testing, and a Declaration reporting thereon has been prepared and is submitted herewith showing that a separator containing high-modulus fibers is superior to that without high-modulus fibers, with respect to the resistance to penetration.

When the battery separator containing high-modulus fibers and exhibiting the excellent resistance to penetration in accordance with the present invention is used, a battery having a long lifetime can be reliably assembled. Such an advantageous effect of the battery separator of the present invention is neither disclosed nor suggested in the Aikawa et al reference. Therefore, Applicants respectfully submit that the battery separator of the present invention, which has the advantageous effect as indicated above, would **not** be easily conceivable from the disclosures in the Aikawa et al reference.

The object of the invention disclosed in the Aikawa et al reference is to provide a nonwoven fabric having a narrow distribution of pore sizes and a good texture, and exhibiting an excellent filtering performance (column 2, lines 16-20). Therefore, one of the objects of the present invention, i.e., to provide a nonwoven fabric exhibiting the excellent resistance to penetration, is neither disclosed nor suggested in the Aikawa et al reference. From this viewpoint, Applicants respectfully submit that the battery separator of the present invention, which can achieve the above object, would **not** be easily conceivable from the disclosures in the Aikawa et al reference.

The JP '595 reference (JP 11-126595)

As described on page 1, line 8 from the bottom to page 2, line 4 of the present specification, the JP '595 reference discloses an alkaline battery separator having a mass per unit area of 15 to 55 g/m², a void rate of 40 to 80%, and a thickness of 0.05 to 0.12 mm, and composed of a laminated nonwoven fabric prepared by adhering fine-fiber nonwoven fabrics onto both sides of a nonwoven fabric produced by a wet-laid method and containing sheath-core type composite fibers consisting of a sheath polymer with a low melting point and a core polymer with a high melting point. Further, the JP' 595 reference does not disclose the "high-modulus fibers" contained in the battery separator of the present invention.

Therefore, the battery separator of the present invention is different from the alkaline battery separator disclosed in the JP '595 reference, with respect to (i) the presence or absence of the “high-modulus fibers” and (ii) a “unilayered structure” or a “laminated structure”.

As to the above difference (i), a separator containing high-modulus fibers is superior to a separator without high-modulus fibers, with respect to the resistance to penetration, as described above.

As to the above difference (ii), the unilayered structure can hold an electrolyte evenly throughout the nonwoven fabric, and thus a battery having a low electrical resistance and a high capacity can be assembled, as described above. In the alkaline battery separator disclosed in the JP '595 reference, however, because of the laminated structure, the electrolyte is unevenly distributed at the fine-fiber nonwoven fabrics, and thus electrical resistance is increased, and as a result, it becomes difficult to enhance the capacity of the battery (page 2, lines 5-15 of the present specification).

In this connection, it is explicitly described in Table 1 of the present specification that a battery separator having a trilayered structure (i.e., the battery separator prepared in Comparative Example 1) showed a poor electrical resistance in comparison with battery separators having the unilayered structure (i.e., battery separators prepared in Example 1-3 and prepared in Comparative Example 2).

The above advantageous effects from the above differences (i) and (ii) in the battery separator of the present invention are not disclosed nor suggested in the JP '595 reference. Therefore, Applicants respectfully submit that the battery separator of the present invention, which has the advantageous features described above, would **not** be easily conceivable from the disclosure of the JP' 595 reference.

In addition, the object of the invention disclosed in the JP '595 reference is to provide a separator for alkaline battery which can ensure a high level of electric insulating function, strength, liquid-retaining performance, and draftiness of the active material required of a separator, by making the separator thin-walled, through conventionally difficult, and lowering the manufacturing cost of the separator (Abstract). Therefore, one of the objects of the present invention, i.e., to provide a nonwoven fabric exhibiting the excellent resistance to penetration, is not disclosed nor suggested in the JP '595 reference. From this viewpoint, Applicants respectfully submit that the battery separator of the present invention, which can achieve the above object, would **not** be easily conceivable from the disclosure of the JP '595 reference.

Further in this connection, the invention disclosed in the JP '595 reference has the object to provide an alkaline battery separator having a high strength. However, the "strength" in the JP '595 reference is different from the "resistance to penetration" in the present specification. As is apparent from the description of paragraph [0032] in the JP '595 reference, the "strength" is a

value measured by a tensile tester, and thus corresponds to a value referred to as the “lengthwise tensile strength” in the present specification. As is apparent from Table 1 of the present specification, the “lengthwise tensile strength” does not correlate with the “resistance to penetration”. Further, as a method to improve the “strength” of the alkaline battery separator, the JP ‘595 reference discloses that a nonwoven fabric produced by a wet-laid method is used (paragraph [0014] and Abstract), that a mass per unit area is 15 to 55 g/m² (paragraph [0018] and Abstract), that a void rate is 40 to 80% (paragraph [0018] and Abstract), that fibers in the nonwoven fabric are fused to each other, and the nonwoven fabric and the fine-fiber nonwoven fabric are fused (paragraph [0019]), sheath-core type composite fibers are used (paragraph [0020] and Abstract), and that the fiber length of fibers forming the nonwoven fabric produced by a wet-laid method is 3 to 20 mm (paragraph [0025]), but does not disclose nor suggest that “high-modulus fibers” are used.

The combination of the Aikawa et al reference and the JP ‘595 reference

As described above, the Aikawa et al reference and the JP ‘595 reference do not disclose one of the objects of the present invention, i.e., to provide a nonwoven fabric exhibiting the excellent resistance to penetration. Further, neither reference discloses or suggests that the “high-modulus fibers” can be used to achieve the object. Furthermore, neither reference discloses or suggests the battery separator of the present invention, which has the above-described advantageous effect obtained from the “high-modulus fibers” contained therein. Therefore, Applicants respectfully submit that the battery separator of the present invention

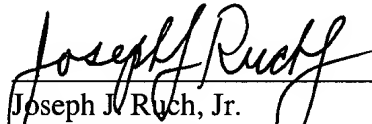
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would **not** be easily conceivable from the combination of the disclosures of the Aikawa et al reference and those in the JP '595 reference.

In view of the above, reconsideration and allowance of remaining claims 1, 3, and 5-16 now pending in the application are believed to be in order, and such actions are hereby solicited. If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned attorney at the local Washington, D.C. telephone number listed below.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

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